



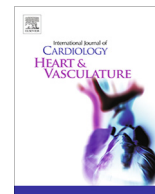
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## Editorial

## The walk of life: Remote monitoring provides insights into physical activity during a pandemic



The COVID-19 pandemic has had a major impact on the health, wellbeing and economic situation of numerous countries. While some effects can be directly related to the virus, others are the indirect consequence of the measures taken in an attempt to control the pandemic. For example, the impact of the lockdowns and related policies that have been instituted in many countries to reduce transmission of the virus on education, wellbeing, and economies have been extensively discussed in scientific and popular media [1]. The potential cardiovascular consequences of a COVID-19 infection have similarly received significant attention. For example, cardiac injury (as defined by elevated cardiac troponin assays) is common in patients hospitalized with COVID-19 infection, occurring in 13%–41% of patients [2,3]. Moreover, structural abnormalities on cardiac magnetic resonance imaging are common after COVID-19 infection, but causal relationships of these tissue changes with the initial infection and future cardiac events are largely unknown [3]. Acute COVID-19 infection may increase the susceptibility to AF, as well as promote the evolution of a prothrombotic state [4]. Potential proarrhythmic effects of drugs such as hydroxychloroquine and azithromycin, which were proposed to treat patients with a COVID-19 infection, have also been the topic of intense debate [5,6].

Besides the virus itself and the medication used to treat COVID-19 infections, the measurements taken in an attempt to control the pandemic, together with increased anxiety, have also had an impact on cardiovascular morbidity and mortality. In particular, there has been a pronounced reduction in hospital admissions for a variety of cardiovascular conditions during the first wave of the pandemic, with a substantial deficit in cumulative numbers over a period of several months [7]. However, less is known about how lockdown-induced changes in lifestyle may affect individuals with cardiovascular diseases.

Previous work has suggested a pronounced reduction in self-reported physical activity during the COVID-19 pandemic [8]. In the current issue of the *International Journal of Cardiology Heart & Vasculature*, Bertagnin et al. [9] investigated the effect of COVID-19-related lockdown on objective measures of physical activity, heart rate and thoracic impedance in 211 heart failure patients with cardiac implantable electronic device (CIED)-based active home monitoring. The authors identified a 25.9% relative reduction in physical activity during the lockdown period compared with the control period (active time per day 8.0% vs. 10.8%;  $p < 0.001$ ). A small 2.2% decrease was also noted for mean heart rate while thoracic impedance exhibited a slight but significant increase (82.2 vs.

82.7 O;  $p = 0.001$ ). In addition, patients were interviewed to obtain patient-reported information on physical activity, anxiety, depression and medication use. Interestingly, patients' perceptions about physical activity showed a very low correlation with remote CIED-assessed physical activity levels, highlighting the importance of objective measures enabled by modern telemonitoring equipment, mobile health applications and wearables.

In some ways, the COVID-19 pandemic provides an interesting natural experiment to assess the impact of certain lifestyle factors on cardiovascular characteristics. Conceptually, the link between physical activity and cardiovascular disease is well established. Physical inactivity is a key modifiable risk factor for heart failure exacerbation and arrhythmias [10,11]. Conversely, (intense) exercise is an important trigger for arrhythmias in patients with catecholaminergic polymorphic ventricular tachycardia and certain forms of long-QT syndrome and arrhythmogenic cardiomyopathy, as well as being a risk factor for atrial fibrillation [12,13]. However, how more modest changes in day-to-day physical activity may affect arrhythmogenic risk is incompletely understood. While the current study, including 211 patients with home monitoring, is likely underpowered to detect differences in the incidence of arrhythmias, especially given the skewed nature of the data, it is interesting to note that the number of episodes of ventricular tachycardia, ventricular fibrillation, and the occurrence of anti-tachycardia pacing are numerically considerably lower during the lockdown period in the study by Bertagnin et al. [9]. In agreement, O'Shea et al. [14] recently reported in 5963 ICD patients a significant 32% reduction in ventricular arrhythmias needing device therapies coinciding with measures of social isolation, although changes in physical activity were not reported in this study.

Of course, the lockdown and the COVID-19-related circumstances that necessitated these lockdowns may also induce numerous other changes that can affect cardiovascular health and/or arrhythmogenesis, including increased anxiety, dietary changes, as well as reductions in air pollution due to the reductions in traffic and closure of shops and factories [15]. Unfortunately, in contrast to physical activity, these factors are hard to measure objectively in an individual patient. Moreover, the cardiovascular effects of these factors may exhibit complex interactions and may depend on the duration of the COVID-19-related circumstances. For example, a reduction in physical activity might initially reduce the occurrence of arrhythmogenic triggers, but in the long term, the negative impact of physical inactivity on heart failure and general cardiovascular health may increase arrhythmogenic risk again.

Together, these data indicate that COVID-19 has had a tremendous direct and indirect impact on cardiovascular health. The COVID-19-related lockdown and fear of infection have drastically reduced physical activity, which in the short term appears to coincide with a reduced incidence of cardiac arrhythmias in heart failure patients. Advances in telemonitoring using data from CIEDs, mobile health applications or wearables are providing unique opportunities to objectively and longitudinally quantify the temporal relationship between risk factors, lifestyle components and cardiovascular outcomes. The growing possibilities for remote monitoring of rhythm and risk factors were used widely for remote assessment and management of patients through teleconsultation during the COVID-19 pandemic [16,17] and will benefit patients long beyond the lockdown restrictions.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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